WFUMB 2022
ABSTRACT

Lung ultrasound of the dependent lung detects real-time changes in total lung volume in a preterm lamb model

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Aim

Effective lung protective ventilation requires reliable, real-time estimation of lung volume at the bedside. Neonatal clinicians lack a readily available imaging tool for this purpose. We aimed to assess the ability of lung ultrasound (LUS) of the dependent region to detect real-time changes in lung volume, visualize pulmonary hysteresis and identify opening and closing pressures of the lung.

Methods

LUS was performed on preterm lambs (n=20) during *in vivo* mapping of the pressure-volume relationship of the respiratory system using the super syringe method. Electrical impedance tomography was used to derive regional lung volumes. Images were blindly graded using an expanded scoring system. The scores were compared with total and regional lung volumes, and differences in LUS scores between pressure increments were calculated.

Results

Change in LUS scores moderately correlated with changes in total lung volume (r=0.56, 95% CI 0.47-0.64) as well as correlating with whole (r=0.41, CI 0.30-0.51), ventral (r=0.39, CI 0.28-0.49), central (r=0.41, CI 0.31-0.52) and dorsal (r=0.38, CI 0.27-0.49) regional lung volumes. The pressure-volume relationship of the lung exhibited hysteresis in all lambs. LUS was able to detect hysteresis in 17 lambs (85%). The greatest changes in LUS scores occurred at the opening and closing pressures.

Conclusions

LUS of the dependent lung region moderately correlated with real time changes in total and regional lung volume. Pulmonary hysteresis was detected by ultrasound 85% of lambs. LUS was able to identify opening and closing pressures. LUS may be useful in assessing lung volume at the bedside and guiding neonatal respiratory support.